NOTES ON MOTOR CARRIAGES

J. H. KNIGHT

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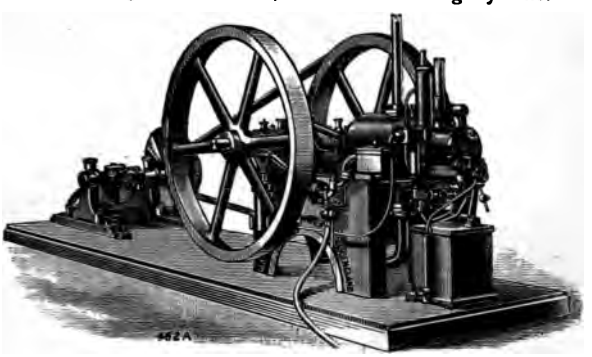

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NOTES ON

MOTOR CARRIAGES

WITH

HINTS FOR PURCHASERS AND USERS

BY

JOHN HENRY KNIGHT

AUTHOR OF "ELECTRIC LIGHT FOR COUNTRY HOUSES, ETC

With Illustrations

LONDON

HAZELL, WATSON & VINEY, LIMITED

1, CREED LANE, LUDGATE HILL, E.C.

1896

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NOTES ON MOTOR CARRIAGE

CHAPTER I.

INTRODUCTORY.

MECHANICAL power on common roads is now exciting considerable attention in England.

Electrical and steam power have been substituted with success for horse power on tramways, and it seems reasonable to suppose that the heavy omnibus traffic of London and other towns could be worked by means of some other power than that of horses. For busy men, for doctors, and for all who now make much use of horses, mechanical power will enable them to do their travelling more rapidly, and more cheaply than they can with horses.

There is a limit to the distance a horse can cover in a day ; and many men keep two or three horses, whereas a good motor carriage would do the work quite as well.

Then there is the large army of cyclists, the vast majority of whom have never ridden on horseback,

and can hardly hope to become the possessors of even the modest cob or pony. The cyclist as he advances in years will begin to feel the want of some auxiliary power to carry him up the hills, that for years past he has ridden up ; and the time must come when he will find it more comfortable to be propelled, than to pedal his machine. This man, with his mechanical knowledge of cranks and ball bearings, of chains and pneumatic tires, will take very kindly to the new conveyance.

A few words as to the origin of this little book. The author had paid two or three visits to Paris—two on purpose to see what the French engineers were doing in mechanical carriages ; and in the early summer of 1895 a short magazine article was written on the subject, but owing to absence from home and a serious accident it was not then published. By the autumn it was out of date ; for events had moved rapidly in this country and in France in 1895.

In November a lecture was given by the writer on the subject, at the Camera Club ; and this, enlarged and brought up to date, forms the chief part of this little book.

Whether motor carriages will ever become as popular in England as they appear to be in France, it is impossible to say. The French undoubtedly have better roads than we have in England. Still our

English roads are far better than they formerly were; the steam roller has done good work, and there must be few Highway Boards or District Councils on which there are not one or two cyclists who realise the necessity for good roads. Thousands of miles of our roads should be widened, so that it should not be necessary for the carriages, either those drawn by horses or propelled by machinery, to slacken speed when passing one another, or risk running off the macadamised surface on to the soft turf or the ditch. A wide road is more easily kept in repair, than a narrow one where all the wheels go in the same track: a wide road is more durable, as it dries more quickly after rain, than a narrow lane shut in with banks and hedges.

The adoption of the safety bicycle and the pneumatic tire has given a vast impetus to cycling; and thousands of individuals are now riders who would never have attempted to ride the old ordinary cycle, with its fifty or fifty-four inch wheel, or even the tricycle of fifteen years ago. Therefore it seems reasonable to suppose that in the near future some light motor, oil, steam, electricity, or possibly hot air, will be produced, that will require scarcely any attention for days together, and give no more trouble in working than the average sewing machine.

The motor carriages of the present year will undoubtedly be as different from that of twenty years hence, as the old boneshaker of 1870 is to the modern safety with it pneumatic tire.

There will necessarily be vehicles of several types. The light motor cycle for two passengers, fitted with a simple petroleum or steam engine : such vehicle will in the writer's opinion become extremely popular. There will be the carriage, worked also by steam or petroleum, of a stronger and heavier type, for six or eight passengers ; and the heavy omnibus carrying its twenty to thirty people.

The great advantage of the mechanical carriage is that when not in use it costs nothing ; whereas a horse standing day by day in the stable proverbially eats his head off.

Cleaning and attention should be very much less than that required by a horse : the cost of working, as will be shown below, will be much less than the cost of horses and carriages.

The early motor carriages must necessarily be somewhat imperfect, but improvements will rapidly take place ; and what the cycle has done for young England, motor carriages will do for the professional man, and those who cannot afford to keep a horse and carriage.

One of the most enjoyable ways of spending a holiday is going for a driving tour ; but the dis-

tance that a pair of horses can cover day by day is about twenty or thirty miles. A cyclist will do three times this distance easily ; hence, for touring, the cycle has become very popular with both sexes. But in the motor carriage we have a conveyance that will not tire, and should be made powerful enough to run at fair speed in the face of a gale of wind and on muddy roads. The writer believes there will be a great demand in the summer and autumn for these carriages, so that three or four friends can spend a few weeks enjoying the scenery of England, or the unbeaten tracks of France and Germany.

CHAPTER II.

HISTORICAL.

DURING the last few months a great deal has been heard in England of the horseless carriages running in Paris, and the trials in 1894 on the highroad between Paris and Rouen, and in 1895 the somewhat sensational race from Paris to Bordeaux and back, have drawn attention to the mechanical carriage — the "voîture automobile" of the French.

But the mechanical carriage is not a French invention. It is true that the first vehicle moved by steam was constructed by a Frenchman, Cugnot, towards the end of the last century; and the identical machine is preserved in an ancient church attached to the Conservatoire des Arts et Metiers, in Paris. It is said that Cugnot suffered imprisonment for his invention, but in his old age he received a small pension from Napoleon. Many text books on the steam engine contain an engraving of this ingenious carriage.

In the histories of the steam engine will be found a drawing of a model steam carriage made

by Murdoch, the assistant of James Watt, and the inventor of gas lighting. An amusing story is told in Smiles' "Lives of the Engineers," of the terror and alarm of the rector of Redruth, in Cornwall, on meeting the tiny model in the twilight, when the inventor was trying its running powers on a smooth and level road near Redruth church. Murdoch was a Cornishman, and was at that time employed by Boulton and Watt in erecting and supervising their pumping engines in Cornwall. A full-size model of the little engine is in South Kensington Museum, and in the same room is one of Trevithick's high-pressure engines and a small model of a self-moving engine, believed to have been actually made by the hands of that ingenious man.

Probably to Trevithick is due the credit of making and running the first steam coach on the highways, in 1803, or perhaps a year or two earlier.

Trevithick, whose partner, Vivian, probably found the money for the venture, brought an engine and coach to London. In the Life of Trevithick it is shown that the steam coach ran through some of the chief streets of London on more than one occasion. Whether the engine and coach were on the same wheels, or whether the engine was used to draw the coach after it, appears doubtful. There is no doubt that he exhibited in London an engine running on

circular rails and drawing a carriage after it. It is therefore possible that this was the engine used in the steam coach. Some of the drawings in the above-mentioned book appear to have been made years afterwards, from the description given by those who had seen the carriage ; and one or two drawings appear to be very incorrect.

The fifteen years from 1820 to 1835 were busy years with inventors ; the railways of England were being mapped out, the locomotive, from a crude experimental machine, had attained success, and had arrived at the type with which we are familiar in the present day. Then the inventors of steam carriages and steam coaches were busy, and it seemed at one time that it was even possible that, for light passenger traffic, the steam carriage might drive the four-horse coach off the road. Some very high speeds had been attained by some of these carriages. The coach proprietors were well aware that higher speeds were required ; self-acting brakes or skid-pans were introduced to avoid delay in taking off the pan at the bottom of a hill. Several plans were proposed to store up the power expended in running down hill to help the coach up the next incline. The tops of many hills on the main roads were cut off and corners shortened ; and probably the surface of the roads at that period were nearly as good in summer as they are at the

present time, notwithstanding the increasing use of the steam roller.

Amongst the many successful pioneers of steam coaches were Walter Hancock and Goldsworth Gurney. There are others whose names should be mentioned: Summers and Ogle, Church, Macerone, Dance, and probably dozens of others whose names are lost to us at the present day.

Hancock published a small book in which he very modestly relates what he had done, and gives fair working drawings of several parts of his carriages; and the writer believes that if any competent engineer took up Hancock's ideas and methods where he left off, but, of course, building everything according to modern practice, such a carriage would run the French petroleum carriages very hard, even if it did not prove that "steam had had its revenge."

Fig. 1 is one of Hancock's carriages. They were mostly of the char-a-banc or double-body coach type, and do not appear to have carried outside passengers. Several were running for months between the Bank and Paddington, and continually to Brighton, Windsor, and other places.

A company was formed to provide capital to build and work these carriages, but disagreements ensued, hindered, and eventually stopped the work. There were several excellent arrangements in these

carriages ; the boiler consisted of a number of flat iron chambers, placed side by side and clamped together. Sir F. Bramwell has described this boiler as a number of books placed side by side ; but a better idea can be obtained by taking a number of cigarette boxes and placing them on end, with a small intervening space. In the actual boiler the chambers were kept in their places by

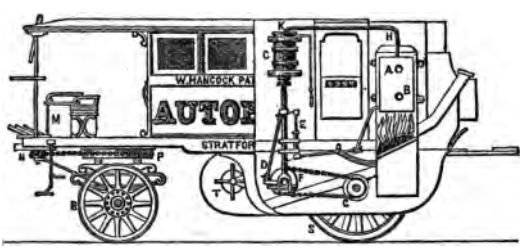

FIG. 1. HANCOCK'S STEAM CARRIAGE. A.D. 1833.

bolts, one at the top and one at the bottom ; short pieces of pipe, which were slipped over the bolts, affording communication for steam and water between the various chambers. The boiler was placed above the firebox in a casing lined with fireclay ; the flame played up between the chambers. The fire was forced by a fan ; there was no visible chimney as in our locomotives or traction engines.

Every one who has had any experience with steam boilers is aware that, after a comparatively

short time, clinkers form on the firebars and check the draught. It is a tedious and laborious process cleaning the bars. To avoid this and the waste of time on the road, Hancock cast his firebars with a rack on the underside; a pinion, turned by a handle, geared into the rack, so that the bars could be pulled from under the fire, and a clean set of bars drawn in simultaneously. Of course, when the clinkered bars became cool the clinkers would easily fall off.

Hancock's wheels were an improvement on the ordinary coach wheel; they had metal bosses, and were very similar to the wheels used at the present day on our field-gun carriages and military water carts.

Gurney and the majority of makers of steam coaches drove direct on to a cranked axle, which carried the driving wheels. Hancock used a separate crankshaft, and coupled it to the road axle by a chain passing round grooved and toothed pulleys on each shaft. The engine and carriage were mounted on springs.

These carriages, judging from the engravings, cannot have been objectionable in appearance and must have been far more sightly than those made in after years. Sir F. Bramwell in his "Reminiscences of Road Locomotives," read before the British Association in 1894, says there was no visible cloud

of white steam, except at starting on damp, foggy mornings.

In Gurney's steam carriages, or rather steam coaches, the cylinders were horizontal, and coupled

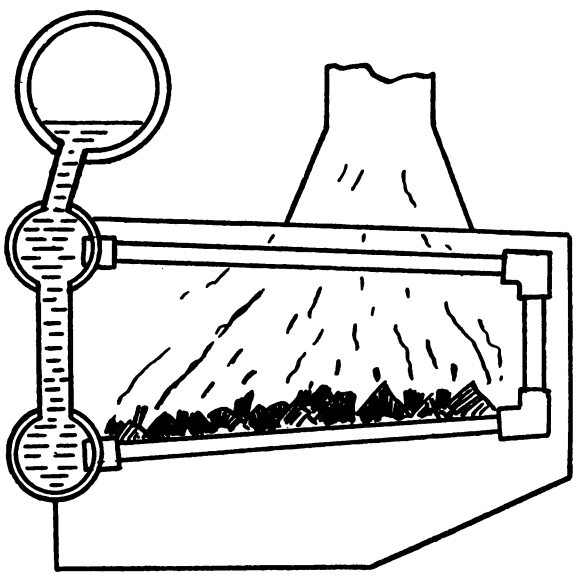

FIG. 2. GURNEY'S BOILER.

to the hind axle, which was cranked as in a locomotive. The coach part alone was on springs —that is, if the drawings are correct—and the machinery must have been subject to all the jolts from the roughness of the roads. The boiler was tubular, and is shown in fig. 2 which is copied

from Gordon's "Locomotion"; it consisted of two horizontal tubes or drums, and connecting these two were a number of tubes bent in a ⊃ form, the lower leg of the ⊃ formed the bars of the grate, two vertical circulating tubes connected the two horizontal drums, and a large drum above formed the steam space.

Doubtless this boiler made steam very fast, but it must have been far from economical to work.

Gurney's coaches were steered with a fifth wheel, which in its turn steered the forecarriage. This is the same arrangement used for many years by Aveling and Porter, the well-known traction engine makers of Rochester.

Gurney's coaches ran for some months between Gloucester and Cheltenham.

Gurney also built some steam drags, the engine being a light traction engine to draw a coach. These steam drags are stated to have weighed only thirty-five hundredweight, but this must have been without fuel and water.

The steam coaches met with much opposition. Doubtless they often frightened horses, and their very success alarmed the owners of coaches; and landowners and farmers naturally imagined that, if steam replaced horses on the road, the demand for hay and oats would be considerably reduced.

Therefore Acts were hurried through Parliament levying exorbitant tolls for steam carriages. For instance, on the Liverpool and Prescot Road a steam coach would pay £2 8*s*., while a stage coach with its four horses would only pay 4*s*. On other roads the charges were often six times the ordinary coach toll. All these unfair acts were passed notwithstanding a committee of the House of Commons to enquire into the working of the steam carriages. And before this committee, Mr. McAdam, probably the son of the inventor of macadamised roads (if not the inventor himself), gave evidence "that, adding the weight of the horses to that of the coach and company, the injury done to the road by a steam carriage of a weight equal to that of the coach and horses (the wheels being of a proper width of tire), the deterioration of the road will be much less by the steam carriage than by the coach and horses." The celebrated engineer Telford gave similar evidence.*

Any one living in the neighbourhood of a military station must have noticed the enormous damage to the surface of the roads by a regiment of cavalry; and the statement that sixty per cent. of the wear and tear of the roads is done by the feet of the

* Gordon on "Locomotion," page 163.

horses that draw the loads seems well within the mark.*

Not content with levying the heavy tolls, heaps of stone were laid across the road, in the hopes of smashing the steam carriages, and so driving them off the road. Mr. Gordon tells us that on the Gloucester and Cheltenham road on June 22nd, 1831, a large layer of stones, said to be eighteen inches deep, was laid from side to side; the horse coaches were stopped, and only got through after the passengers alighted, and in some cases the harness was broken to pieces; waggons were obliged to get extra horses. The steamer got over the obstruction twice, but the third time broke its axle.

It was at this period that great difficulty was experienced in getting Parliament to pass any railway bills, and opposition had to be met with bribery. The prejudices against railways was intense, and any new invention was looked on with suspicion. The introduction of thrashing machinery caused dissatisfaction among agricultural labourers, and stacks of corn, and even farm buildings, were wantonly set on fire in most counties of England; hence it is hardly a matter of surprise that steam

* The writer has often seen in the neighbourhood of Aldershot a fair county road, that has had a good surface, rendered more like a sea beach after one or two cavalry regiments have passed over it.

carriage makers who were not supported by large capital, as the railway companies were, gave up their business in despair.

The explosion of the boiler of one of Scott Russell's carriages in Glasgow, with fatal results, was the cause of considerable alarm and distrust among the residents in the district.

This may be called the end of the experimental period. Railways were stretching in all directions and there seemed hardly any demand for other means of locomotion. But in the fifties and sixties, the years that saw the birth of the traction engine, light steam carriages were made by Ricketts, Yarrow, Tangye, Carrett, I. W. Boulton, and by the writer, and others. They mostly had boilers of the locomotive type, but some had vertical boilers. These boilers were probably double the weight of those used by Hancock and Gurney; the steam turned up the chimney caused noise; coal was often used instead of coke while, if the boiler primed, a shower of black rain would descend on collars and cuffs, and the parasols and dresses of the ladies. In the year 1868 and two following years the writer ran several hundred miles on the common road with a carriage of his own construction. It was not very successful, and on two occasions met with what might have been very serious accidents—once running away down a steep

and long hill, and at another time a pin in the steerage got loose, the carriage, turning sharply round ran, through a hedge into a hop garden. Both these accidents might have been avoided with care and foresight.

It may not be generally known that the early traction engines were simply portable engines, with road-gearing added, and intended simply for moving themselves and thrashing machines from farm to farm. Gradually the engines were improved and adapted for road work.

A form of traction engine introduced by Thompson of Aberdeen requires more than a passing notice. Thompson was the first to use wheels with india-rubber tires; but the engines were of a peculiar construction, with vertical boilers having a copper pot or globe in the firebox. These boilers were not good steamers, and undoubtedly caused the failure of some of the early engines of this class.

The writer watched the working of two of these engines, which were used by the War Department at Aldershot for some period, often riding alongside them for considerable distances, and he was much impressed with their handiness, and power of dragging heavy loads over sandy and loose ground. But the great expense of the tires, adding £150 or £200 to the cost of the engine, was a serious matter.

Several firms took up the manufacture of the Thompson road steamer. The Indian Government purchased several for working trains of goods and passengers on some of the trunk roads of Northern India. They worked for many years a regular train service, till the narrow gauge railways were laid down, and the road steamers no longer required.

It seems possible that some modified form of elastic wheel may yet be found suitable for traction engines. The French have used pneumatic tires on their petroleum vehicles, some of which with their passengers must weigh at least one and a half tons.

Elastic wheels have been introduced by Burrell, McLaren, I. W. Boulton, and others; but they would hardly come within the scope of this book.

A steam dogcart was made and patented by the Messrs. Blackburn in 1877. A torpedo engine was the motor. A coil of tubing was used for the boiler, which was heated by petroleum, urged by a blast from a fan worked by the engine. The steam was condensed in an air condenser, which consisted of a large number of tubes arranged round the circumference of a fan, so that they were exposed to the cooling effect of a strong current of air. The Road Locomotive Acts

stopped Messrs. Blackburn's car from being used in England.

The steam tricycle of Sir Thomas Parkyns, made by Mr. A. H. Bateman, of Greenwich, also came under the arm of the law, in the now celebrated case of Parkyns *v.* Priest.

CHAPTER III.

EXPLANATORY.

UNTIL the last four or five years, in all attempts to use mechanical power on the road, steam was used.

Now the choice lies between steam, petroleum, electricity, compressed gas, and air; and it is quite likely that some form of producer gas, or water gas, may soon be used.

Explosives have been suggested; and one inventor suggested working a tricycle, by dropping into a cylinder at each stroke a pellet or cartridge of some slow-burning powder.

The pellets or cartridges were to be stored in a hopper near the rider; but the inventor does not seem to have realised the possible danger of the whole contents of the hopper exploding, through a leaky valve or other defect in the mechanism. However, as sportsmen do not hesitate to carry in a bag, or in their pocket, sufficient cartridges for a day's shooting, it is quite possible that some perfectly safe method of using explosives may be eventually discovered. But in petroleum vapour we have an explosive that, at the early part of the

stroke, gives a pressure sometimes as high as two hundred pounds on the square inch. It must be presumed that the reader has some knowledge of mechanism, and some superficial knowledge of the steam engine. If the would-be purchaser of the motor carriage thinks that it is like the kodak, where all he has to do is to "press the button," he will be mistaken.

It is advisable that every man, and certainly some women, should have some knowledge of machinery and of the working of a steam or gas engine ; and should have some intelligent idea of what takes place in a steam boiler, and in the cylinder of a steam or gas engine.

The writer would suggest that if the reader can manage to spend an hour or two with the driver of a small steam engine, who will carefully explain all he knows, and then on the day when the engine is being overhauled, if he can see the piston drawn and the slide-valve cover removed, he will get a better idea of the vitals of a steam engine than by studying a text book. The writer remembers, as a boy at school, spending many half-holidays in a locomotive shed, where small repairs were done ; and through the kindness of the foreman he picked up a great deal of information, which was of use in after time. In those days it was not difficult to make friends with a driver, and get a ride on the

locomotive of a goods train, or even on passenger engines if the station-masters on that branch were not likely to report any infringement of the company's rules.

However it seems improbable that the steam engine will be the favourite motive power in the future self-propelled carriages, at least for private vehicles; but for heavy omnibus work it may probably be used.

The gas engine, with its offshoots, the petroleum and oil engine, is fairly well known. The largest makers of gas engines in England, Messrs. Crossley, state they have an engine in every town in Great Britain; but it must be understood that the petroleum engine used in the French carriages differs in many respects from the Otto gas engine.

It may be well to explain that the Otto gas engine and the Otto principle is almost exclusively used at the present day. It consists of a cylinder and piston, which act alternately as a pump and motor, that is, there is one effective or working stroke only in two revolutions of the crank-shaft. If the reader will watch an engine at work, he will notice that there is generally a shaft at right angles to the crank-shaft, and which revolves at half the speed. This works the valve and causes the piston to act alternately as a motor and a pump. He will also notice, at least on all modern engines, the firing

tube—a tube about $\frac{1}{4}$ or $\frac{3}{8}$ inch in internal diameter, heated to redness in a Bunsen flame. As the

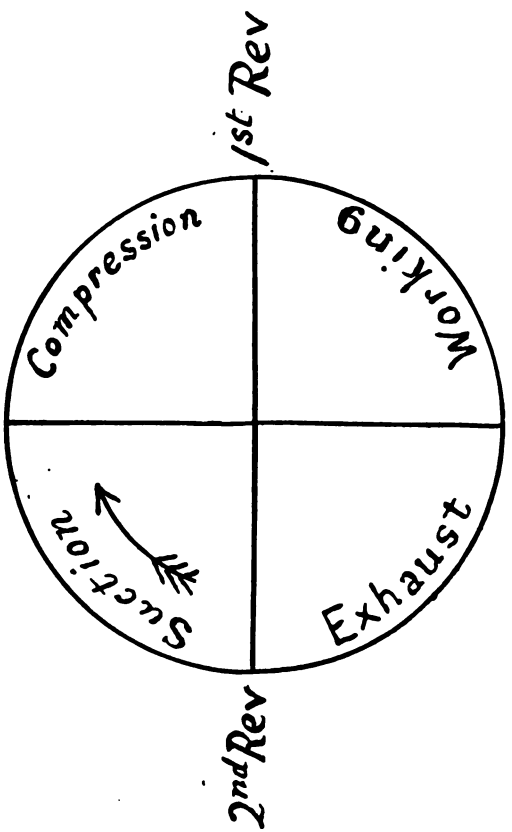

FIG. 3.

mixture of gas and air are forced into this tube by the compressing action of the piston, they explode

or fire, causing a very high pressure to operate on the piston.

In the first outstroke, air and gas are sucked in.

In the first instroke air and gas are compressed.

In the second outstroke they are fired, and do work on the piston.

In the second instroke the exhaust or burnt gas is expelled.

The action may be explained by the diagram, which represents two revolutions of the crank or the working cycle of the engine. See fig. 3.

The Otto engine is the survival of the fittest. Before the Otto patents expired there were many engines with pumps to force in the air and gas, and thus avoid Otto's claims. Some engines were made with one firing stroke only in three revolutions. By this means the burnt gases were expelled completely, and the working stroke was more energetic ; so that practically there was little loss by this apparently complicated arrangement.

Unlike the steam engine in which steam presses on both sides of the piston, all gas-engine makers, with one exception, make their engines single-acting.

The oil engine is a gas engine with a vaporiser for making the oil into vapour (not oil gas, as it has been sometimes erroneously called, but rather oil steam), and this vapour must enter the cylinder

at a temperature considerably above that of boiling water. There are several devices for vaporising the oil, all covered by patents acquired by the makers of the various engines. Some vaporisers are heated by the exhaust gases. This method was used first by Messrs. Priestman, who made the first oil engine placed on the English market. Other makers use the heat produced by the working of the engine, and inject a small quantity of oil into an extension of the cylinder.

An oil engine known as the Trusty, made under the patents of the writer and Mr. J. E. Weyman, is represented in fig. 4. At the end of the cylinder is the vaporiser, a cast iron chamber with spaces or passages surrounding the extreme end of the cylinder, and which is kept at a high temperature by the explosion or combustion of the oil vapour. To start the engine the vaporiser is heated by a blast lamp, oil is then pumped in by a small oil force pump, the fly-wheel turned two or three revolutions by hand, and the engine starts; the supply of oil being maintained by the small oil-feed pump. A hot tube, heated by the blast of an oil lamp, urged by a jet of air from an air pump, fires the charge of oil vapour and air at the proper time.

Some hundreds of these engines are working in all parts of the world, driving machinery

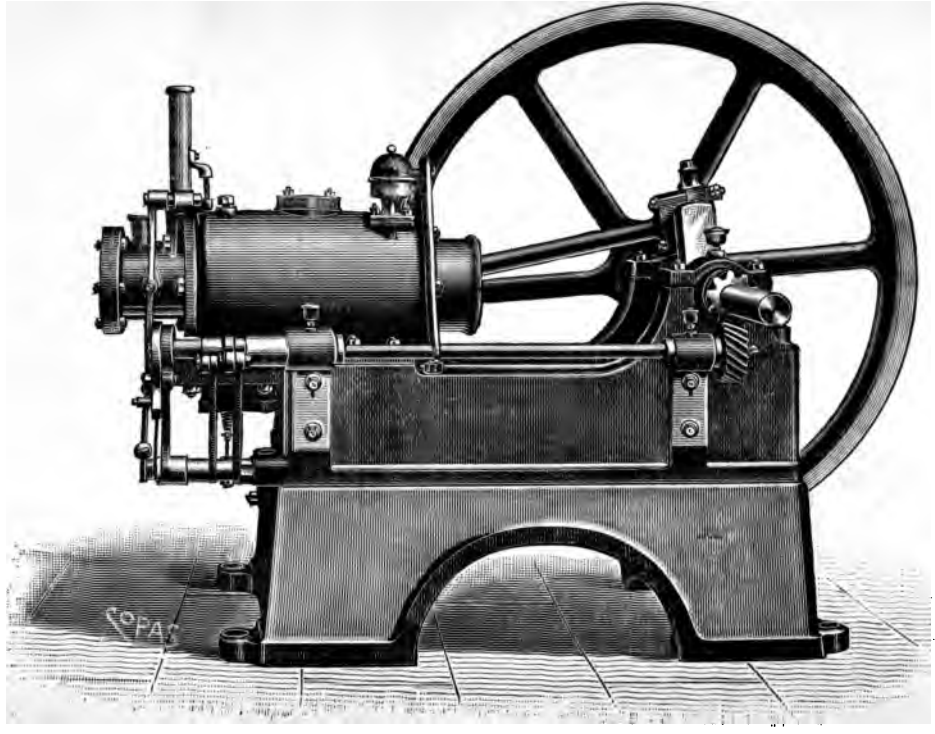

FIG. 4.

in workshops, pumping, sawing, electric-light plant, etc.*

It must be distinctly understood that what in England is meant by an oil engine is an engine using the ordinary lighting oils, kerosine or paraffin —oils known as Tea Rose, Royal Daylight, Water White, Russoline, etc.—and not gasoline or benzoline. These light products are classed as petroleum by Act of Parliament, for they give off inflammable vapour below 73° Fahr. Such light oils have not found much favour for working engines in this country, but in France, Germany, and the United States they are frequently used. In the motor carriages of Continental make, these light oils are used; and, notwithstanding their giving off vapour so readily, do not seem to have been the cause of any accidents.

Gas and oil engines require a water jacket to prevent overheating the cylinder. The weight of this water is somewhat an objection to the use of petroleum in motor carriages, and several methods have been suggested of rapidly cooling it, so that the quantity carried should be very small.

In the early steam carriages, with one or two exceptions, the engines were coupled directly to the

* Engines under Knight and Weyman's patents are being manufactured by Messrs. Clayton and Shuttleworth, of Lincoln.

road wheels; they were therefore slow-moving engines, for a four-foot wheel only makes (nearly) seventy revolutions per minute, at ten miles per hour. Now an engine running at only seventy revolutions per minute would be working at a very slow rate, and to obtain the necessary power, the cylinders must be of considerable dimensions, and correspondingly heavy. If instead of running the engine at seventy revolutions per minute, it were run at four times the speed, two hundred and eighty revolutions, an engine of one-fourth the capacity would do the work, and such an engine would be only about one-third the weight of the slow-moving engine running at only seventy revolutions per minute. The light, quick-running engine would be geared to the wheels as one to four, the engine making four times the number of revolutions as the road wheels. This gearing is usually done by chains, as in bicycles. Ordinary spur-gearing would not permit the play of the springs, and all shocks would be transmitted to the engine. In a slow-moving traction engine there is not the same objection: the wheels are large and the weight crushes down loose stones, which would affect a lighter carriage. Many makers now put their traction engines on springs.

There are certain devices common to all motor carriages. With few exceptions there are two or more

speeds. Common roads, unlike railways, generally follow the surface of the ground ; and to surmount a hill increased power is necessary. This is attained at the sacrifice of speed. If on fairly level roads, the engine is coupled with road wheels as one to four. On encountering a hill, the gearing is altered, so that the engine may make eight or more revolutions to one of the road wheels, and the speed of the carriage is correspondingly reduced. We have an example of changing the gear in cycles in the crypto two-speed gear, which was frequently used on tricycles ten or fifteen years since. Another instance of change of speed is in the different diameters of the pulleys on lathes, the mandril running faster or slower by shifting the gut or band. In a motor carriage the speed must be changed instantly, without stopping the engine or carriage ; for on undulating roads the speed might require altering a dozen times in a mile.

To enable the carriage to turn corners, the driving wheels are not keyed to the axle as in a locomotive, for if they were it would be difficult to deviate from a straight line ; so the wheels are loose, and coupled by the compensating or differential gear. This gear consists of two bevel or mitre wheels, one keyed to each wheel or to a hollow axle in which is the main axle. These wheels are driven by a pinion, fixed in a central wheel, to which motion is com-

municated from the engine; but this pinion does not revolve on its stud or axis, it simply acts as a driver when the carriage is on a straight road; but if one wheel meets with extra resistance, the pinion moves on its stud and the outer driving wheel overruns the inner.

This arrangement is used on tricycles. It is some-

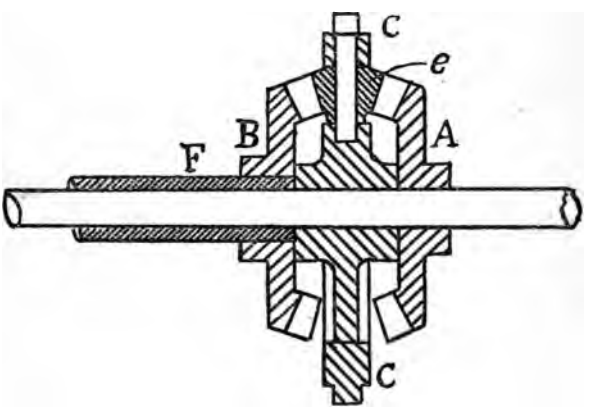

FIG. 5.

times called the jack-in-the-box motion. It is shown in fig. 5. The mitre wheels, A and B, are connected with the right and left driving wheels, the chain or gear wheel, C, which receives motion from the engine carriage, and mitre pinion, *e*, gearing with A and B, so that when one road wheel overruns the other the pinion moves slightly on its spindle—still transmitting force to both wheels.

The writer thinks that in many small carriages this refinement is unnecessary. In the steam carriage alluded to in the previous chapter, one wheel only was a driver; and, except on wet grass, the wheel was never found to slip.

He has also ridden in one of the Serpollet carriages in Paris, in which one wheel only was the driver. However, in snowy, frosty weather it is quite possible that such a carriage might prove far inferior to one in which both wheels were drivers.

Steerage.

It might be thought that the problem of arranging the steering of a motor carriage would not be difficult; but to steer a small carriage by turning the forecarriage has only to be tried to find how impracticable, if not dangerous, it is.

Gurney's arrangement of steering with a fifth wheel in front was excellent. The makers of early traction engines got over the difficulty of steering, by having shafts attached to the engine and using a horse for steering. As the horse had no work to do he was able to cover many miles in the day, if required to do so.

Aveling and Porter, as before alluded to, used Gurney's fifth wheel on their early traction engines, but it was difficult to steer into gateways at right

angles to the road, and for moving backwards it was very awkward; besides, the steersman, being seated on a low seat in front of the engine, was exposed to considerable danger in a collision.

At the present time the locking of the forecarriage of a traction engine is effected by a worm wheel and chains. If a chain should break there is nothing to prevent the forecarriage turning round and throwing the engine off the road. Besides, this is an extremely slow method of steering, and only suited for slow-speed engines. If, however, a quicker motion is used, so as to turn more sharply, a great strain is thrown on the arms and hands of the steersman; if one wheel strikes a stone, or drops into a hole in the road, it might cause the forecarriage to turn, and an accident might happen.

Using only three wheels obviates the difficulty; and, if the weight of machinery and passengers be kept well on the hind wheels this method appears quite safe. The Thompson engine, alluded to above, had three wheels only.

One objection to the three-wheel carriage is that in narrow roads the steering wheel has to run on the track of the horses' feet, and not on the smooth surface rolled down by the wheels.

If the steering wheel be of considerable diameter, the fork carrying the wheel must be a weak point;

if the wheel is small, extra vibration and resistance are the result.

The strain on the fork and its supports is certainly reduced, by making the fork to rake as in the modern safety bicycle.

The method adopted by the Continental makers is to pivot each front wheel at the end of the axle.

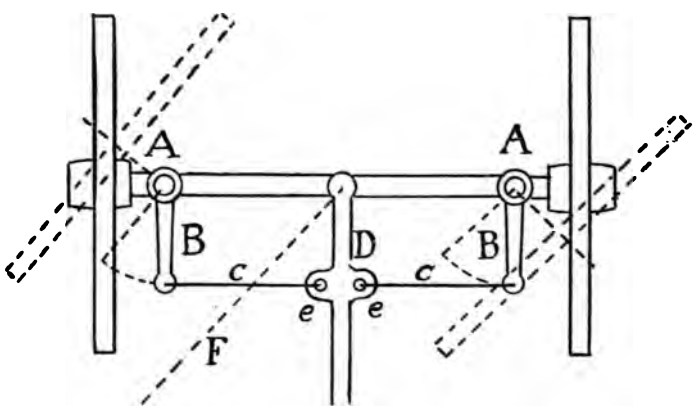

FIG. 6.

This will be easily understood by reference to fig. 6 : AA is the axle, which is fixed and does not swivel, but each wheel runs on a stud or trunnion pivoted at A; and at right angles to these studs are two levers, B,B, by which the wheels are swiveled. The steering handle, D, is pivoted near the axle ; it is coupled to the levers, B, B, by rods C, C. When the handle is

pushed over to the position F, the wheels assume the position shown by the dotted lines.

In setting out this arrangement, it is necessary to remember that the inner wheel must turn through a greater angle than the outer, for the outer wheel describes a larger curve than the inner.

This difference in the angles moved by the wheels is obtained by putting the pins, *e*,*e*, not in the centre line of the steering handle, but each one a little on one side.

CHAPTER IV.

MODERN MOTOR CARRIAGES.

THE restrictions on using mechanical carriages, as in England, do not exist in any other country. French and German inventors have long been at work. One of the earliest, and one of the most successful, makers of motor carriages is M. Serpollet, of 27, Rue des Cloys, Paris. In the Serpollet system steam is used, but not generated in a steam boiler of the ordinary type. The instantaneous steam generator, as it is termed, consists of a coil of steel tube, which tube is flattened so that its area is extremely small, as in fig. 7.

The coil of tubing is heated in a furnace; and water being pumped in at one end, steam comes off at the other. There are several modifications of this generator, but this is the principle on which it works. The carriage is best described in a letter to a local paper, written on the writer's return from Paris in the summer of 1893.

"On arriving at M. Serpollet's works in Montmartre, I found him and two other men, who, like myself, had come to see the carriage, on the point

of starting. The carriage is of the phaeton type. The steersman sits in front, and at his right hand are the levers for working the starting pump and the brake; at the after part of the vehicle is the steam generator and coke-box. A lad was with us, who, as far as I could see, was not required during the journey.

"We started over some very rough paving at about seven miles per hour. The visitor to Paris,

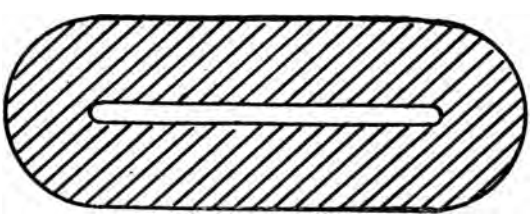

FIG. 7.

who only sees the excellent roads in the neighbourhood of the Rue de Rivoli and the Champs Elysees, will, if he goes to Montmartre (the working-class district of Paris) find very different roads. It was over this rough road we jolted for a mile, or more, till, coming to the outskirts of the city, M. Serpollet showed what his carriage could do; for, on a stretch of wide, level road, we ran for several hundred yards at about fourteen or fifteen miles per hour.

FIG. 8. SERPOLLET STEAM CARRIAGE.

"On returning, a long hill, about as steep as Pentonville hill, was run up at good speed, quite ten miles per hour, all other vehicles being overtaken and passed; this, however, was an excellent road, paved with wood. The machine ran very well; there was very little noise from the machinery, and it was under perfect control. There was no escape of steam or smoke, the products of combustion escaping near the ground at the rear of the carriage.

"When we returned to the factory I remarked to M. Serpollet that, unfortunately, such a carriage as his would not be allowed to run in England.

"He replied, 'You English are a clever people, but your laws are bad, very bad.'"

The carriage mentioned in this letter carried coke for about thirty-five miles, and water for twelve to fifteen miles. It was, however, of an old type, and rather roughly finished. Improvements have doubtless been made by this time.*

Many tramcars are now fitted with Serpollet generators, and are doing good work in and around Paris.

It might be thought that the tube would choke with deposit from the water, but this is seldom

* A Serpollet carriage, with all latest improvements and compound engines, and fitted to burn either coke or oil, has lately been ordered by an Englishman.

found to be the case. They are occasionally washed out with some chemical preparation, which dissolves or removes any scale or obstruction.

Coil boilers are by no means new; they have been frequently used in steam launches, and one was used in the Blackburn steam dogcart of 1877 alluded to on page 22.

A steam drag, by MM. Dion and Bouton, of Paris, was shown at Sir David Salomon's show of horseless carriages, at Tunbridge Wells. It was generally thought to be too cumbrous for use in England, and it emitted large quantities of steam.

It had been in use in France for some years, and was only sent to prevent disappointment, as the engine that was being built for the show could not be finished in time. The senior partner of this firm, the Count de Dion, has been experimenting with mechanical power for carriages, for many years. His first steam tricycle was made from a tandem tricycle, one seat being removed, and replaced by the engine and boiler.

A steam tricycle has been brought out by MM. Sautenard et Cie., 25, Rue de la Folie, Mericourt, Paris. They describe it as follows:—"Weight, one hundred and twenty kilogrammes in working order; speed eight to twenty kilometres an hour. Tubular boiler, claimed to be inexplosible, of one square metre heating surface, and heated by two petroleum

blasts. The boiler is in front of the passengers, and it is easily manipulated."

The engine is horizontal with two cylinders, tandem—*i.e.*, one behind the other—and both working on the same crank. One or both cylinders can be worked, at the will of the driver, according to the state of the road.

A steam brake is fitted. There are three speeds, and the road wheels are driven by chain gearing.

The wheels are fitted with pneumatic tires. Sufficient oil or petroleum essence for four hours is carried, and water for thirty-five kilometres. The tricycle carries two passengers.

CHAPTER V.

PETROLEUM CARRIAGES.

THE petroleum carriages which made such an excellent record in the Paris-Rouen contest of 1894, and in the Bordeaux race of last year, have drawn a vast amount of attention to the use of motor carriages. Two motor carriages both worked by Daimler petroleum engines were shown at Tunbridge Wells; one built by MM. Panhard and Levassor, and one by MM. Peugeot freres, whose works are at Valigntiny, near the Swiss frontier. These latter have a depôt for carriages near the Porte Maillot, Paris. A carriage of the former makers is shown in fig. 9. It was a similar carriage to this that was the first to arrive in Paris in the race to Bordeaux and back.

The engine is placed in the box-like casing in front; the crank-shaft is below the cylinders, which are vertical. The engine is started by turning the winch handle seen in front; the semicircular casing beneath the carriage covers the gearing. The petroleum is carried in a tank at the back of the engine casing, and will carry sufficient for a run of

fifty miles. The exhaust silencer is the long transverse cylinder at the rear of the carriage. There are four speeds, varying from about three miles per hour for hill climbing to twelve or thirteen for level roads. The carriages are geared

Fig. 9.

according to the districts they are going to work in.

The makers state that the slow speed will take the carriage up an incline of one in ten, on a road that is dry and in good order. There are two brakes—one worked by the foot, the other by hand ; this latter is employed on long, steep descents, or

for sudden stops. The majority of these makers' carriages are fitted with indiarubber tires.

The cost of the petroleum is stated to be four centimes per kilometre for the carriage for two passengers, and five centimes for the carriage for four, the latter in English money being a trifle over three farthings per mile ; but in France there is an import duty on all mineral oils, consequently the price is higher than in England.

The carriages are made of almost all types, the gig, dog-cart, phaeton, and small omnibus being shown at the works, Avenue d' Ivry, in the south-east of Paris. The prices seem rather high according to English ideas, but M. Levassor assured the writer he had as much work as he could do, being then (May 1895) overwhelmed with orders.

The Peugeot carriages have the engine at the back ; the framing is made of steel tubes, and some carriages are fitted with pneumatic tires. One of these carriages, belonging to the Salvation Army, in France, has run seven thousand miles without repairs.

A Peugeot carriage has lately crossed the St. Gothard Pass, driven by the owner, accompanied by his wife, an engineer, and a dog, with seventy kilos. of baggage. It may be said that, if a petroleum carriage will cross this pass, it will go anywhere. See fig 10.

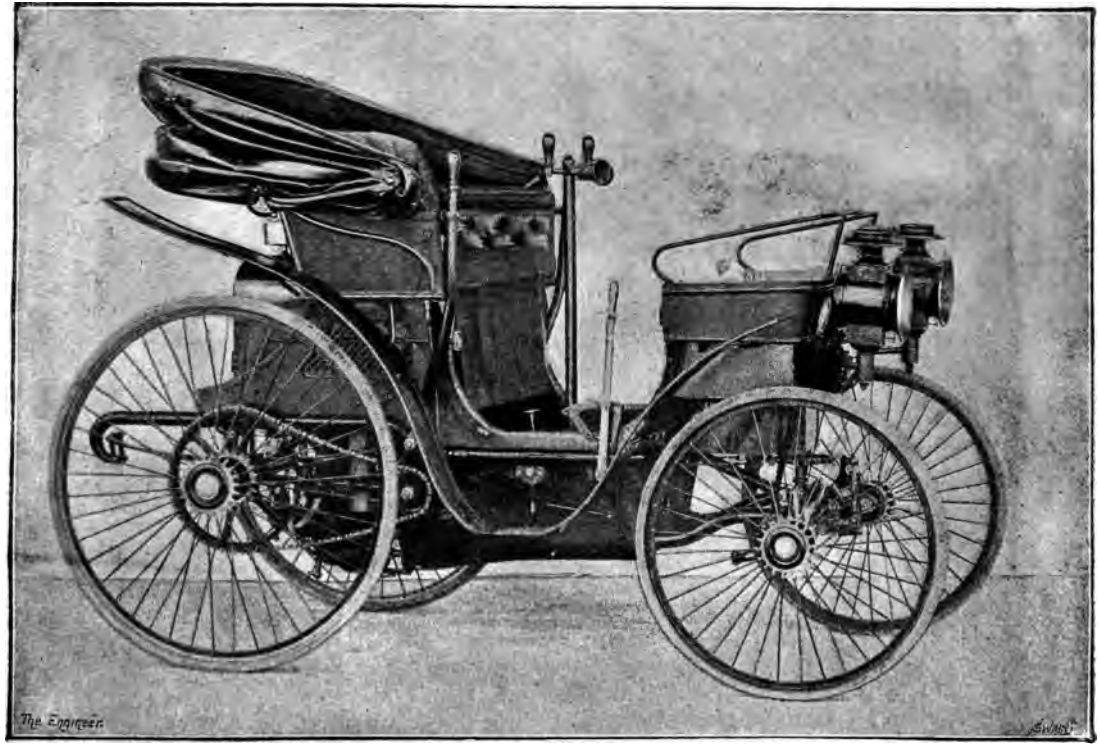

FIG. 10. [From the *Engineer*.]

All the French carriages are worked with gasoline or benzoline, having a specific gravity of ·700 or less, and giving off an inflammable vapour at a very low temperature. These light hydro-carbons are called, in France, Essence de Petrole. There are certain advantages in using these light oils instead of paraffin or kerosine. The carburator is more simple in construction than the vaporiser of an oil engine, and rather more power is obtained. It is clean in working and emits very little smell ; on the other hand, as has been mentioned above, it is more explosive than the lamp oils, and requires far more care in using and handling. However, its use does not appear to have caused any accidents.

The vertical engines of the Daimler type cause considerable vibration when the carriage is at rest ; for it must be understood that the engine is always running at a speed of seven hundred revolutions, and the speed of the carriage is altered by changing the gearing ; it is only when a halt of some little time is made that it is desirable to stop the engine. When the carriage is running the vibration is not noticed.

In the Roger carriage, which is made under the patents of Herr Benz of Mannheim, the spur-gearing is done away with ; a couple of belts and two pairs of fast and loose pulleys permit the speed to be changed at will. One great advantage of this

arrangement is that it is almost silent in working, easily repaired and kept in order, and considerably

FIG. 11.

cheaper than the gearing of the other makers mentioned above. The firing is effected by the electric spark. M. Roger's works are at 52, Rue

des Dames, Paris. A company have taken up the patents and are starting works at Maidstone.

The writer commenced the construction of an experimental oil engine carriage in the spring of 1895, and in July it was running with benzoline; after running a short time with the light hydrocarbon the oil vaporiser was attached, and it has since been running with ordinary lamp oil. It is shown in fig. 11. The hind wheels are 3 feet in diameter, steering wheel 2 feet 6 inches. All are fitted with 1½ inch solid indiarubber tires. The total weight including oil and water is about 5¼ cwt. About three gallons of water are carried, which is sufficient for an hour or an hour and a half run; the cylinder is 3½ inches diameter, and 4½ inch stroke; the speed is 500 revolutions per minute. The engine differs somewhat from that shown on page 30. It was designed specially with the view of making a very light, but strong, high-speed engine. There are two speeds equal to about eight miles per hour, and three and half for hill climbing. These speeds are altered by tightening one of two belts, running on different sized pulleys, by means of jockey pulleys, the handles for working which are in front of the steersman, and are seen in the photograph. It runs on three wheels; probably four wheels would have been better. The engine is started

by turning a winch handle on the left side of the carriage.

The engine gives about one brake horse power. A larger engine would have been better, and is certainly necessary for rough winter work. The engine being placed horizontally and carefully counterweighted, the vibration is much less than in the French carriages ; a lever acting on the governor reduces the speed of the engine when the carriage is standing.

An oil motor carriage must of necessity be fitted with a governor, and thus one advantage is that the carriage is prevented from racing. It will run down a moderate incline at the same speed as on the level, the carriage driving the engine, and the engine thus acting as a brake. If the road is fairly level, distances may be measured with something like accuracy by timing the carriage ; for as the engine runs at a uniform speed, the speed of the carriage is the same whether on a level or going down hill ; of course, going up hill the slow speed is used.

The writer believes this was the first petroleum or oil carriage for two passengers that was made in England. This little carriage ran about one hundred and fifty miles on the public roads till it was stopped by the action of the Surrey County Council.

There are many advantages in using oil instead of benzoline. It can be obtained in almost every village in England, the quantity required for a long run is comparatively small, and, with a good engine and light carriage for two passengers, one gallon of oil should last for twenty or twenty-four miles on fair roads.

If, however, the oil be used to raise steam in a boiler, or an instantaneous generator of the Serpollet type, at least double the quantity of oil will be used, for it is a known fact that the steam engine is a very wasteful motor ; in fact, oil and gas engines are superseding steam engines for small power in thousands of cases.

Tests of a Trusty oil engine of four nominal horse power made by Mr. W. Worby Beaumont in 1892 gave an oil consumption of ·82 lb. of oil per brake or actual horse power, taking the cost of the oil at fourpence per gallon (the wholesale price at that time) the cost of working was nearly ·35 of a penny per brake horse power per hour.*

This engine gave nearly six brake horse power, and it must not be expected that the toy engines used in motor carriages, and giving one and a half to three or four brake horse power will give quite such excellent results. Assuming a carriage for

* At the present price of oil (February 1896) the cost would be at least a halfpenny per horse power.

two people was fitted with an engine of two brake horse power, and that the engine actually burnt as much as one-third of a gallon of oil per hour, the speed being eight miles per hour, one gallon of oil would run the carriage twenty-four miles at a cost of sixpence, or one farthing per mile. To this must be added the cost of lubricating oil—new firing tubes, or, if an electrical firing gear is used, the wear and tear of the battery or accumulator.

Then the cost of the wear and tear of the carriage must be taken into consideration. What this should be time alone can prove ; but oil and gas engines last a long time and, unlike steam engines, do not require an expensive overhaul every four or five years. Even if the cost of running came to one penny or even three-halfpence per mile, no horse and light carriage could be run for less money.

Turning to the trials at the Plymouth meeting of the Royal Agricultural Society in 1890, which are the last published trials of small engines with which the writer is acquainted, the compound engine of Messrs. Simpson and Strickland used 4·099 lb. of coal per indicated horse power. This would be equivalent to 4½ lb. per brake horse power, the weight of the fuel being five times greater than that used by a moderately good oil engine. But if we take the cost of the fuel, assuming the coal to be purchased at twenty shillings per ton, the cost

of running is more than the oil engine, being a trifle over three farthings per brake horse power per hour; and to this must be added the cost of fuel in raising steam.

Coal would be inadmissable to use in carriages running in our streets, as it is extremely difficult to entirely obviate smoke ; coke or anthracite must be used, and the cost would be slightly greater.

If we turn to the accounts of the early steam carriages, we find that the fuel and water difficulty was a serious one. Hancock describes how on one occasion he ran short of coke ; and one of the passengers went on by a passing coach to the next town, and a supply of coke was sent out to the steam carriage. The uncertainty of finding water on roads that were not known to those in charge of the carriage must often cause delay and annoyance. The quantity of water required with a petroleum carriage is very much less than is necessary with steam, and if certain cooling apparatus (many already have been patented), will act as well as their inventors anticipate, runs of thirty to sixty miles might be made before the water required renewing.

No successful attempts have hitherto been made with either gas or petroleum engines to do without the water jacket, except in very small engines ; but it is quite possible in the near future that some

arrangement of forcing air round and into the cylinder, and so cooling it, may be successfully adopted.

The tricycles of MM. Dion and Bouton, and of the Gladiator Co. of Paris, deserve notice.

FIG. 12.

The former is shown in fig. 12. It is an ordinary, strongly made tricycle, with the gasoline engine at the rear and geared to the axle ; the engine runs at a very high speed; there is no water jacket, but the cylinder is cooled by having a large number of

radiating plates (like the grills of a Gurney stove) cast round it, and when the tricycle is in motion the air passing among these plates, cools them, and keeps the temperature of the cylinder within working limits. The firing is done by electricity—a Ruhmkorff coil, and a double-cell battery, or couple of accumulators, being carried on the machine. One of these tricycles was shown at the Tunbridge Wells show. It is not intended that the engine should do all the work, except on level ground; uphill the rider must exert himself, and assist by pedaling.

The Gladiator Co.'s machine has the steering wheels in front, and the after wheel, which is central, is the driving wheel.

CHAPTER VI.

ELECTRICITY.

THE writer regrets he can say nothing about electric carriages. If certain difficulties could be overcome with accumulators, possibly the electric carriage would be preferable, for town work at least, to steam or petroleum.

For the benefit of those readers who have not given any attention to electrical matters, it may be explained that an accumulator is a secondary battery. It will not produce electricity, as plates of different metals will, but when the plates of an accumulator are connected to a source of electricity, they undergo a chemical change and so store or accumulate a certain energy, which, on the plates being connected to an electric motor, or to some lamps, will produce an electric current.

The plates of these accumulators are made of lead. The chief drawbacks to their use in motor carriages are their weight, their cost, the comparatively small charge they can contain, and the length of time required to charge them. If, in the near future, some or all these drawbacks can be

removed, electricity may prove itself better for motor carriage work than either steam or petroleum.

Professor Ayrton, many years ago, fitted some accumulators and a small electric motor to a tricycle, and exhibited it at work in the library of the London Institution. Mr. Magnus Volk the originator of the electric railway on Brighton beach made an electric dogcart, and ran it several times up and down the King's Road, Brighton. Attempts have also been made with primary batteries to work cycles and small carriages ; but the cost of working these, even if they were successful, would prevent any possibility of success.

Mr. Ratcliffe Ward had an electric omnibus running for many months in London ; but the writer has not been able to see it working. A Coventry and Birmingham firm made in 1894 an electric carriage, which is stated to have attained a speed of twenty miles per hour for a short distance, on the road between these towns. It had pneumatic tires of considerable size.

CHAPTER VII.

THE FRENCH CONTESTS.

ANY account of motor carriages would be incomplete without some notice of the contests from Paris to Rouen in 1894, and from Paris to Bordeaux and back in 1895. Those who are interested in the subject, will find a long account of the former contest in the *Engineer* of July 20th and 27th, 1894.

The contest was arranged by the proprietors of *Le Petit Journal* and prizes amounting to £400 were offered. The first prize was for the best vehicle for four passengers; a carriage for two, although it might be the first to arrive, would only receive the second prize.

As police regulations only permitted in towns, and in the department of the Seine, a speed of twelve kilometres per hour, or seven and a half miles, no attempt was made to race.

The final trial took place on Sunday, July 22nd, the three previous days being spent in preliminary trials to towns about fifteen or twenty miles from Paris. If any vehicles failed in these preliminary trials, they were debarred from the race to Rouen.

Although a hundred and one vehicles were entered only forty-six turned up. Of these, one-half were worked by petroleum engines, twelve by steam, and one by electricity. They were reduced to twenty-one on the final trial on Sunday. The distance to be run was seventy-nine or eighty miles, the road in places being steep but with long, level stretches.

Travellers to Paris by the Newhaven and Dieppe route obtain glimpses of the road which was traversed by the carriages. The curves and inclines on the railway from Paris to Rouen do not admit of the same high speed as between Paris and Calais, and doubtless the road has its fair share of ups and downs. The start was made from the Porte Maillot on the outskirts of the Bois de Boulogne at 8 a.m., intervals of two minutes being allowed between the starting of the several carriages. Luncheon was taken at Mantes, and Rouen was reached by the first carriage—the steam drag of MM. Dion and Bouton—at 5.40. Some five or six petroleum carriages came in during the first half-hour.

The route was lined all the way with spectators, many having travelled considerable distances to see the contest. Flowers and fruits were handed or thrown to those in the carriages as they passed. The first prize was equally divided between MM.

Panhard and Levassor and MM. Peugeot. The second prize was awarded to MM. Dion and Bouton, the third to M. Blant for his carriage with Serpollet steam generator.

This contest shows that, not only was the petroleum carriage a rival of the steam carriage, but that most of the steam carriages were out of the running. The result, to those who knew but little of what was being done in France and Germany, came as a complete surprise. The majority of the petroleum carriages were fitted with Daimler motors, using, as has been said before, the light hydro-carbons, gasoline or benzoline.

Notwithstanding what our neighbours were doing, nothing seems to have been done in England to agitate for a repeal of the law, or to bring the matter before the British public for another year.

The June race, Paris to Bordeaux and back, of last year was on different lines. Instead of being organised by the proprietors of a newspaper, it was originated and carried out by well-known men in sport and commerce. Among the committee the following names are known to English readers :— the Baron de Zuylen de Nyevelt, MM. Gordon Bennett, Vanderbilt, Henri Menier the chocolate manufacturer, and Marcel Deprez the electrician.

Sixty-nine thousand one hundred francs was

subscribed for prizes. The course was from Paris to Bordeaux and back, a distance of about seven hundred and forty-four English miles.

After deducting five thousand francs for expenses the prizes would be as follows :—The first arrival in Paris, 50 per cent. ; the second arrival in Paris, 20 per cent. ; the third arrival in Paris, 10 per cent. ; the four following, 5 per cent. But the first prize could only be taken by a carriage containing four people.

An entrance of two hundred francs was paid by the owner of each vehicle.

The steersman and driver might be changed during the contest.

Any manufacturer might enter any number of carriages, provided they were of different types and dimensions.

Instead of the full number of passengers, the vehicles might carry seventy-five kilogrammes of ballast for each vacant place.

No repairs were allowed to be done, except by those in the charge of the carriage, and with tools carried with them.

It was thought that this last regulation would prove fatal to a large number of vehicles, and on a speed contest of nearly eight hundred miles it must be admitted to be extremely stringent.

Maps of the course were provided for the com-

petitors. Direction posts were placed at turnings, and flags, or at night signal lamps, were placed at descents that might be deemed dangerous; flags and lights were also placed at some short distance from the railways which were crossed on the level.

Before the race the carriages had been on public view for three or four days at the Gallerie Rapp, on the Champs de Mars; and at 9 a.m. on June 11th, the twenty-nine vehicles were drawn up at the Arc de Triomphe for the start. From thence, down the Avenue de la Grande Armée, a quiet run was made to Versailles, where the actual start took place. A Paris journal, *Le Velo*, thus describes what took place at Versailles.

"At Versailles there was considerable excitement. All the cafés had been crowded; 'voitures automobiles,' other than those contesting, were there in considerable numbers, and were going on the road to carry provisions for those engaged in the contest.

"Upon the Place d'Armes, a tent with flags and the insignia of the Touring Club of France is arranged for the control. In this tent are those members of the committee who are appointed to superintend the start.

"Each carriage as it arrives is placed in position. At 11.45, only nineteen out of the twenty-five

carriages are in their places, besides the two bicycles automobiles.

"The crowd at this time has increased; those in charge have difficulty in preserving order; fortunately no accident happened.

"It is exactly 12.5 when the order is given to start."

It is impossible to give any description of what took place on the road. The traction vehicle of Dion & Bouton appears to have led as far as Blois, one hundred and ninety-two kilometres from Paris, but was passed before reaching Tours by Panhard & Levassor's No. 5, which then took the lead and kept it to Bordeaux and back.

Again quoting *Le Velo.* "The turning place at Bordeaux. The town presented all day an animated appearance, chiefly on the road where the automobiles were expected. The pavements were black with people. The cafés of the Bastide have been crammed with people waiting for the carriages, and discussing them with great interest. At 10.30 a.m. M. Levassor arrived at the turning point, the Café Anglais de Bordeaux, steering his No. 5, which has been called the record coach of automobilism. It is a phantom carriage. It reached Bordeaux in twenty-two hours and a few minutes.

"The crowd cheers the victor of the first half of

the course, and the ovation seems as if it would never stop.

"The stop is made for the judges to certify the arrival of the carriage, a bystander offers M. Levassor a glass of champagne which he drinks without quitting his seat; and at 10.40, eight minutes after arrival, M. Levassor starts for Paris amid the acclamations of an enthusiastic crowd."

The next carriage, a Peugeot of two places, did not reach Bordeaux till 2.10.

Le Velo of June 14th heads its notice, "The Triumph of Petroleum." "M. Levassor has actually arrived yesterday, June 13th, at fifty-seven minutes past noon atthe Porte Maillot after having driven a carriage 'a deux places,' and without help the whole way from Paris to Bordeaux and back, one thousand two hundred kilometres, in about forty-eight hours. A few minutes before one, those at the Porte Maillot saw a cloud of dust approaching, and at noon fifty-seven minutes thirty seconds M. Levassor stopped his carriage at the winning post. It was covered with dust, and flowers thrown to him by his admirers. M. Levassor alighted in the midst of cheering, and M. George Berger addressed him a few words of congratulation. M. Levassor did not appear tired, notwithstanding he had been more than forty-eight hours without sleep."

M. Levassor stated that he lost considerable time, by having to slow down during the night, owing to the difficulty in keeping his lamps burning, the vibration at that high speed causing one to become unsoldered; besides, he said he ran with prudence, never exceeding thirty-eight kilometres per hour downhill. The carriage, just as it arrived, covered with dust and flowers, was taken to the exhibition at the Gallerie Rapp.

The Dion-Bouton and the Serpollet carriages had to abandon the course, as did also the electric carriage of M. Jeantard. This was worked by accumulators, and a special train was chartered to convey the charged accumulators to various points on the route.

The only steam carriage which went the whole distance was M. Bollee's, a steam omnibus which had been in use for nine or ten years; and to him a supplementary prize was awarded.

The first, third and fourth prizes were awarded to MM. Peugeot; the second and fifth to MM. Panhard and Levassor; the sixth and seventh to M. Roger.

These races were noticed in nearly all the English daily papers; and shortly afterwards Mr. Shaw Lefevre gave notice in the Commons that he would introduce a bill to remove restrictions on light carriages under two tons, and not used for

traction purposes. The Rosebery Ministry going out in the end of June nothing further was done.

Shortly after this, in July, the proprietors of the *Engineer* newspaper stated they would offer a sum of £1,050, to be given in two or more prizes, for the best motor carriage. This has probably set hundreds of engineers, and also scores of amateur mechanics, working at the problem. One of the conditions is that light hydro-carbons, gasoline, and benzoline are excluded; this will shut out the Daimler engine, and other Continental carriages.

The judges are well-known engineers and will doubtless be assisted by competent men. The course and time of the contest are at present not fixed, but there is every reason to suppose that the prize will bring to the front some carriages that will be far better than any yet produced.

CHAPTER VIII.

AMERICAN MOTOR CARRIAGES.

In America land transport has been carried to a greater degree of perfection than in any other country, our own country not excepted. The long runs on the railways in the United States are not required in England ; and the speed on the railways on the Continent of Europe, with a few exceptions, is below that of America. Within the last ten or twelve years electrical traction has superseded horse traction on many tram lines in cities ; and the electric tram lines have been extended to and beyond suburbs of the cities. But the common roads have been much neglected. The paving in the streets of New York city has long been a standing reproach, and the roadways in many southern and western cities are often but little better.

J. K. Fisher tried a steam carriage in the States about the year 1858. He abandoned it after some years of experiment, when it was represented to him that English engineers, who had far better roads to run on, had failed to make steam carriages a success.

Self-propelling engines for hauling thrashing-machines from farm to farm have long been in use in the wheat-growing districts of America. The American traction engine is considerably lighter than that made in England.

At first sight it is not easy to see why a traction engine working in the States may be made much lighter and less powerful than one made and used in England. But the reason doubtless is that corn is cut and thrashed much earlier in the summer than it is with us ; and on the dry prairie or wheat-growing land the engine can run nearly as easily as on a macadamised road ; the work of thrashing being completed before the rains of the autumn set in. In England the traction engine has often to cross a wet field to get to its work, and the strain of going over the soft, boggy land is far greater than any encountered by the American traction engine.

This lightness of construction, which is also seen in the American buggy or waggon, is noticeable in the few motor carriages that have been made in the States. Some of the early motor carriages are copies of the French and German types. The Daimler engine was introduced into the States, and is being manufactured by Steinway, the well-known pianoforte makers of New York.

Fortunately, American engineers and users are not hindered by restrictions, as in England. It was

not till after the French trials of 1894 from Paris to Rouen took place that public attention in the States was drawn to the motor carriage. A Chicago paper, *The Times and Herald*, offered a prize for the best motor carriage. The contest was to take place on November 2nd, 1895. The first prize was $2,000 and a gold medal, the same being open to competition to the world. Second prize $1,500 ; but if the first prize went to a foreign manufacturer, this prize would go to the best American competitor. Third and fourth prizes, $1,000 and $500 respectively, open to all competitors.

The paper stated that it must not be supposed that speed was the only requiste. It proceeded to say, that doubtless, " a clever mechanic could make a machine to outstrip all others in the contest, yet that device might not be of utility from a practical point of view."

Many of the intending competitors declared they could not be ready by the day appointed and the trials were postponed till November 28th ; but to prevent disappointment to the large number of citizens who had arranged to make that day a holiday, and to keep faith with the few competitors who were ready, a " consolation " or preliminary trial took place on November 2nd. Two motor carriages only put in an appearance ; they were the Mueller carrying four passengers, a carriage of the Benz Roger type

described in a previous chapter (this vehicle was made in Germany), this is shown in fig. 13; and the Duryea, of American make, this latter a light carriage very similar in appearance to the American buggy. In the latter the steering is done by a tiller; but the handle of the tiller is rotated, and by rotating the handle the speed of the engine is altered, the carriage stopped or reversed. If this arrangement is found to be practical in every-day work, it must be an enormous advantage to be able to control a motor carriage with one hand only.

The *Horseless Age*, a New York monthly, published in the interest of motor carriages, gives a map of the route. The total distance is ninety-two miles. Starting from Jackson Park, Chicago, the course is in a northerly direction, through Half Day to Waukegan, on the shores of Lake Michigan; then, turning south, the lake is skirted to the winning post in Lincoln Park.

Of the two carriages, the Mueller alone succeeded in running the whole distance, the Duryea unfortunately met with an accident; to avoid colliding with a waggon the driver had to run it into a ditch, which damaged one of the wheels, so that it was impossible to proceed further.

The following report of the judges is quoted from the *Engineer* newspaper: "The number of miles actually run was ninety-two; the gross time taken

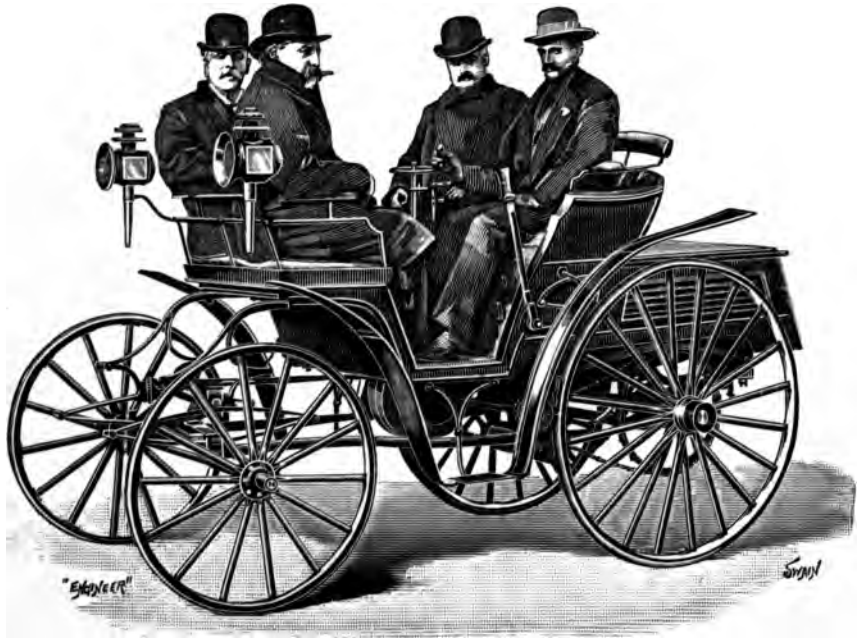

FIG. 13.

by the Benz (Mueller) motor in travelling this distance was 9 hrs. 30 mins. The start was made at 9.13 in the morning, and the finish at 6.43 in the evening. In making the run, the only delay allowed by the judges under the rules and conditions of the race was for stops at level crossings of railways, where trains might temporarily block the way. The Benz machine lost seven minutes through this cause; the judges therefore corrected the running time from 9 hrs. 30 mins. to 9 hrs. 22½ mins. This will be the official record of the length of time occupied showing an average speed of, approximately, ten miles per hour."

Thirty-eight and a half minutes also were lost on the road, by having to adjust one of the tires twice, by stoppage of the electrical firing gear, by losing the road, and by taking in supplies of cooling water and gasoline.

The final trials took place on November 28th, but by that time the winter had set in. Five inches of snow or mud covered the road, so that the course was reduced to fifty-six miles, and although several vehicles came to the starting point, the majority gave up or broke down before completing the contest. The Duryea came in first, but the speed was slow throughout, five to six miles per hour; and this can hardly be considered a fair trial, for although it shows that motor carriages can be

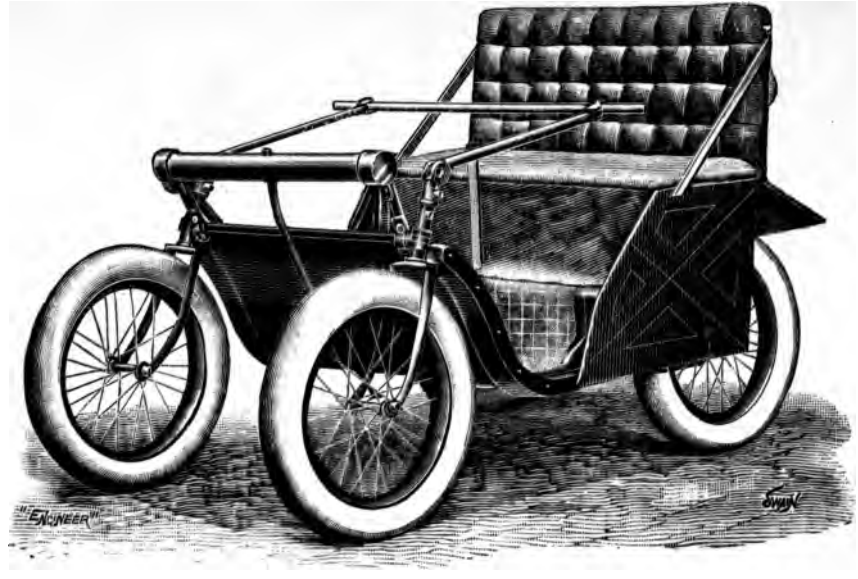

FIG. 14. [From the *Engineer*.]

driven through snow and thick mud, it is not the normal condition under which they have to work.

The American engineers who acted as judges, not only tested the engines for the actual power given, but arranged an apparatus to register the pull on the rim of the driving wheels; thus finding what power was lost or absorbed in the gearing, belts, chains, or other device that might be employed. To ascertain the efficiency of the gears, the driving wheels rested on a large drum which they rotated (the fore wheels being securely fixed). On the axis of this drum was fitted a friction brake or dynamometer, for showing the horse power given off at the rim of the wheel: the horse power of the engine being previously taken, the difference in the two readings would represent the loss of power by transmission.

A very ingenious and light motor carriage, the Kane-Pennington, has been brought to this country. It is represented in fig. 14. Its chief feature consists in its enormous pneumatic tires, and the small diameter of its wheels. The engine is extremely light, and the makers claim that it will work with either light or heavy hydro-carbons. A friend of the writer, who had a ride on it at the Nunhead grounds, stated that it often attained a speed of twenty miles an hour, and went over soft, wet grass at five or six miles, carrying two men and two boys.

FIG. 15. [From the *Engineer*.]

It is to be hoped that some reliable tests will be made with this carriage before long, as it seems to be a type that has many advantages not possessed by others. Its low centre of gravity, and small wheels with the huge tires, would render it less liable to overturn at high speed, or on rough roads, than some of the European carriages.

A bicycle fitted with a Pennington engine is stated to have run a mile in fifty-eight seconds, on the smooth streets of Milwaukie. This in shown in fig. 15.

Electricity and steam have been tried in the States, but with apparently no greater success than in Europe.

It is to be hoped that some American motor cars may be brought to England, and shown either at the Crystal Palace, or, maybe, running on our streets as soon as the present legal restructions are removed.

CHAPTER IX.

HINTS TO PURCHASERS AND USERS.

A VAST amount of absurd ideas have been, and are, prevalent about self-propelled carriages. The writer hopes to remove some misapprehensions, and to place plainly before his readers what he believes the state of the matter to be. The present machines (certainly those he has seen) are far from perfect, but they can undoubtedly be used by men who have a fair knowledge of mechanics, and who are willing to humbly learn the method of working them. Each year, probably each month, will see improvements ; vibration will be lessened, the machinery simplified, and last, but not least, the cost will be considerably reduced. At present, as far as the writer knows, there are no English makers who will quote a price, or guarantee to deliver a motor car ; the few carriages at present sold in England being of Continental make and the prices charged for them are too high.

The writer believes that within a year or two, a very fair carriage for two passengers will be procured for £75 or £80—that is, if there be

sufficient demand for makers to turn out such motor cars by the hundred. This would be a light carriage, with indiarubber tires, having three or four wheels, with a simple benzoline engine. It would be capable of carrying its two riders, with about fifty pounds of baggage, twelve to fifteen miles per hour on good roads, and doing seven or eight miles against a head wind on a muddy but level road. It should carry petroleum for thirty to forty miles ; and the cooling water, of which a very small quantity need be carried, should not require renewing till after an hour's run. The writer has met men who are anxious to have the first autocar in their town or district, "just for the honour of it." To such men it is useless to say "wait" : but the writer would counsel his readers to await either the results of the trials at the Crystal Palace, or the competitions for the *Engineer's* prize of one thousand guineas, which will probably take place in the autumn. Many comparatively useless carriages will be weeded out ; the *Engineer's* judges, who are men of high standing in the engineering world, will give an unbiased report, that will be of great use to the would-be purchaser.

The purchaser must not expect too much from his motor carriage. Sir David Salomons advises purchasers to see the machine taken to pieces, and put together. This may possibly take up a whole

day, or even more; but it is time well spent and will save many a disappointment afterwards. It is absolutely necessary that those who have charge of motor carriages should understand the machinery they look after. Breakdowns will occur, causing vexatious delays; but by careful management they often may be avoided.

During the last few months the writer has received a great many letters on the subject; some of them are certainly amusing. One lady wishes to purchase a motor to draw her bath chair in place of her donkey, as the animal requires so much care and attention. Several individuals have asked for advice as to fitting engines of some sort to their bicycles or tricycles. One gentleman was anxious to purchase a motor carriage at once; and on it being suggested to him it would be better to defer purchasing for a few months, he replied that he might not live to enjoy its use.

The writer considers that, as the French have attained such remarkable success, and in so short a space of time, English engineers will soon produce far better engines and carriages than anything that our Continental neighbours have yet shown us, and that the future prospects of the autocar are very bright. Villages remote from railways will be brought into communication with the towns; owners of country houses, now tenantless

owing to their isolation, may find in the horseless carriage a means of restoring to our rural districts some of the prosperity they enjoyed in years that are past.

In concluding this little book, it may be well to remind the readers that the public enjoyment of many inventions has been delayed by the patent rights of the inventors and manufacturers; for instance, the telephone and the incandescent electric light. But with the motor carriage there are no patents, at least no master patents, to stop the way. There doubtless will be a crop of improved clutches, driving gears, and the like, but in the case of steam all that is known now was known fifty or sixty years ago. And the Otto gas-engine patent having expired, any one is free to use benzoline or gasoline, if they do not infringe the details of certain carburators.

With the oil engine the case is somewhat different. The oil engines in England are in the hands of some six or eight manufacturers, who work either under their own patents, or under patents they have bought or work on royalty. Amongst these there is and must be competition; and this very competition will be a benefit to the public, the best engines coming to the fore.

It seems to the writer there is no necessity for forming large companies to buy up patent rights

and manufacture. The capital possessed by some of our large engineering firms must be ample to start a new branch of trade, which will probably yield quick returns, as for some years to come the purchasers will be those who can, and will, pay cash for things they buy.

Those who wish for further and more technical information on the subject of mechanical power on roads may consult the following books and journals :—

Hancock's "Narrative of Twelve Years' Experiment of Steam Carriages on Common Roads." 1838 (long out of print).

Gordon's "Treatise on Locomotion." 1832 (out of print).

"Steam on Common Roads." *Young.* 1860.

"Steam on Common Roads." *Fletcher* (Spon.).

Engineering, March 13th, 1891. Description and illustration of the Serpollet carriage and instantaneous steam generator.

Engineer, July 20th and 27th, 1894. Paris-Rouen contest, with illustrations and descriptions of the Daimler, Dion-Bouton, and other carriages.

Engineer, August 17th, 1894. Sir F. Bramwell's paper, read before the British Association at Oxford, "Some Reminiscences of Steam Locomotion on Common Roads."

Engineer, Nov. 22nd, 1895, and Jan. 3rd, 1896. "American Self-propelled Carriages."

Society of Arts Cantor Lectures, Dec. 1895. "Mechanical Road Carriages." By W. Worby Beaumont.

La Locomotion Automobile (monthly magazine). Paris: 2, Place du Caire.